DOCUMENT RESUME

ED 136 236 CS 003 294

AUTHOR Anderson, Richard C.; And Others

TITLE Schemata as Scaffolding for the Representation of Information in Connected Discourse. Technical Report No. 24.
INSTITUTION Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Mar 77
CONTRACT 400-76-0116
NOTE 18p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Advance Organizers; *Cognitive Processes; College Students; Connected Discourse; *Learning Processes; *Memory; Prose; *Reading Research; Recall (Psychological)
IDENTIFIERS *Center for the Study of Reading (Illinois); *Schemata

ABSTRACT

Subjects read narratives about a meal at a fine restaurant or a trip to a supermarket. The same 18 items of food, attributed to the same characters, were mentioned in the same order in the two stories. As predicted from current formulations of schema theory, foods from categories determined to be part of most people's restaurant schemata were better recalled by subjects who read the restaurant narrative. Also as predicted, subjects who received the restaurant narrative were more likely to recall the character to whom a food had been attributed. However, contrary to expectation, subjects were equally likely to reproduce food-order information, whichever passage they had read. Information of the same significance in the context of either the restaurant or supermarket story was equally well recalled by the two groups. (Author)

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CENTER FOR THE STUDY OF READING*

Technical Report No. 24

SCHEMATA AS SCAFFOLDING FOR THE REPRESENTATION OF INFORMATION IN CONNECTED DISCOURSE

Richard C. Anderson, Rand J. Spiro
and Mark C. Anderson

University of Illinois at Urbana-Champaign

March 1977

University of Illinois
at Urbana-Champaign
1005 West Nevada
Urbana, Illinois 61801

Bolt Beranek and Newman Inc.
50 Moulton Street
Cambridge, Massachusetts 02138

The research reported herein was supported in part by the National Institute of Education under Contract No. MS-NIE-C-400-76-0116.

*Designation as a Center pending approval.

CS 003 294

Schemata as Scaffolding for the Representation of Information in Connected Discourse

Ausubel (1963, 1968) proposed that a reader's abstract cognitive structures provide the "ideational scaffolding" for the detailed information contained in text. In his words (1968, p. 153), " ... new ideas and information are learned and retained most efficiently when inclusive and specifically relevant ideas are already available in cognitive structure to serve a subsuming role or to furnish ideational anchorage." Bartlett (1932) suggested a similar notion. However, research in the tradition of Bartlett and Ausubel has proved inconclusive. One reason is that until recently schema notions were hopelessly vague. The purpose of this paper is to provide a clearer formulation of schema theory, and then provide an experimental test of some hypotheses that follow from the theory.

Like Bartlett, we shall refer to the mental structures that incorporate general knowledge as schemata. Schemata summarize that which is common to a large number of things or situations. Because of its generality a schematic representation must be more abstract than the representation of any particular thing or situation. As Kant (1781, pp.182-183) explained when he introduced the idea of the schematization two centuries ago, "The schema of a concept ... signifies a rule according to which my imagination can delineate the fiture ... in a general manner, without limitation to any single determinate figure such as experience, or any possible image that can represent in concreto, actually presents."

Schemata, "frames" (Minsky, 1975), or "scripts" (Schank & Abelson, Note 1) give generic characterizations of things and events. To interpret a particular situation in terms of a schema is to match the elements in the situation with the generic characterizations in the schematic knowledge structure. Another way to express this is to say that schemata contains slots or placeholders that can be instantiated (Anderson, Pichert, Goetz, Schallert, Stevens, & Trollip, 1976) with certain particular cases.

With no more theory than we have just outlined, it is possible to give more precise treatment to the notion of ideational scaffolding. A schema will contain slots into which some of the specific information described in a message will fit. The information that matches slots in the schema would be said to be significant, whereas information that does not would be called unimportant, irrelevant, or--in the limiting case---incongruous. Information that fits the superordinate schema is more likely to be learned and remembered, perhaps precisely because there is a niche for it. It follows that one schema can provide slots for more of a certain fixed body of information than other schemata. If the knowledge domain were specified, it should be possible to make qualitative as well as quantitative predictions about just which details will be learned.

The present research involved two passages. One was a story about dining at a fancy restaurant (after Schank & Abelson, Note 1). Most people's dining-at-a-fancy-restaurant schema (or script) will include

the generic knowledge that you ordinarily make a reservation, arrive at the appointed time, and check with a host or hostess, who ushers you to a table. Menus are distributed. A waiter or waitress asks if you would care for a cocktail. Food from characteristic categories is ordered and served. And so on. No doubt there are some elements common to almost everyone's dining-at-a-fine-restaurant schema whereas the presence or absence of other elements probably depends upon cultural, regional, and individual variation.

A second passage involving a trip to a supermarket was constructed to closely parallel the restaurant narrative. The characters and most of the actions and objects described in the two stories were the same. A certain body of information common to both passages was expected to have significance in terms of a restaurant schema. When embedded in the supermarket passage, on the other hand, the same information was perfectly sensible and understandable but it lacked special significance within the framework of a supermarket schema.

Eighteen food items were mentioned in the same order in the two narratives. It was expected that subjects who received the restaurant narrative would learn and recall these items better. Of course, everyone's trip-to-a-grocery-store schema includes slots for food, but these are loosely constrained. Any food item could fit. In contrast, a restaurant schema imposes more structure. For instance, there must be an item suitable for a main course.

The second prediction was that subjects who read the restaurant passage would more often attribute the food items to the correct characters. The reasoning was, for example, that it does not matter who threw the brussel sprouts into the shopping cart, but in a restaurant it does matter who ordered which vegetable. Even if it were supposed that some subjects reading the supermarket passage were contemplating a meal at home, foods are typically shared at a home meal and, therefore, one is not led to code the foods in relation to particular persons.

Third, it was hypothesized that the order of recall of food items would correspond more closely to order of mention for subjects who read the restaurant story. There is not, or need not be, a prescribed sequence for selecting food items in a grocery store, but when eating at a restaurant it would be odd to have chocolate cake before a tossed salad.

In a preliminary experiment involving 47 graduate students from a statistics class, which will not be described in detail, each of these hypotheses received some support.

Method

Subjects. The subjects were 75 undergraduates enrolled in an introductory educational psychology course. An additional 37 subjects from the same population participated in a norming study which provided the skeletal structure of the restaurant script.

Materials. Subjects in the norming study were asked to describe the activities involved in dining at a fine restaurant. The data from

these subjects were remarkably consistent and served as the framework around which the restaurant and the parallel supermarket passages were constructed. As one might expect, the norming study revealed that in a fine restaurant schema there are not only certain categories of foods but also a particular order in which those foods are served (e.g., appetizers, salads, and entrees). The restaurant and supermarket narratives mentioned the same 18 food and beverage items. Each item was a member of one of the categories identified in the norming study. That is, for instance, a shrimp cocktail is in the appetizer category. The order of mention of the food and beverage items was identical in the two passages; it matched the order in the restaurant schema as revealed by the norming data. The two passages were very similar in every respect. All of the actors and most of the action and objects were the same. Events and objects were described in the same order. Several identical propositions, involving a total of 11 idea units, were included in each passage. These propositions were judged to have equal significance from a supermarket or restaurant perspective.

Procedure. The subjects were run in groups of about 20. They participated in the experiment during regular class time. As subjects entered the room, they were randomly assigned one of the two passages. Instructions emphasized that the passage should be read carefully since a test would be given later. Subjects proceeded at their own rate. Everyone read the passage in four minutes or less. After reading the

passage, subjects were given the Wide Range Vocabulary Test (French, Ekstrom & Price, 1963), which lasted 12 minutes. The purpose of the test was two-fold. First, it provided a measure of subjects' verbal ability and, second, it minimized recall from short-term memory.

Following the 12 minute interval, subjects recalled the passage. The instructions stressed that the subject should try to reproduce the entire passage, in the correct order, without leaving out anything. When the exact words could not be remembered, subjects were told to try to capture the gist. Subjects were allowed as much time to recall as they needed. They typically finished in about 10 minutes.

Results

The data were first analyzed in analyses of variance in which the factors were passage (Restaurant or Supermarket) and verbal ability (High, Medium, Low). While people of higher verbal ability tended to do better, verbal ability was never a significant main effect, nor did it enter into any significant interactions.

Food and beverage recall. Subjects who received the restaurant story recalled a mean proportion of .69 of the food and beverage items. The comparable figure for subjects who received the supermarket story was .52. As expected, this was a significant difference, F (1,69 = 8.91, $p < .01$.

A further analysis involved food categories which had a high or a low probability of being included in an individual's restaurant schema. Three categories identified as being part of most people's schemata were

a salad (61%), a before dinner drink (86%), and an entree (100%), where the numbers in parentheses were the percentages of subjects in the norming study who included the category. Three other categories were determined to have a low probability of being in a restaurant schema, as follows: a drink during dinner (21%), desert (29%), and an appetizer (36%). There were two items in the stories from each of these six categories.

While, as we have already indicated, there undoubtedly is some variation in people's schemata, probably the high probability categories are best regarded as obligatory elements of a restaurant schema whereas low probability categories reflect optional elements. In any event, the prediction is that subjects who received the restaurant passage would show better recall of food items that fit into high probability categories, but no better recall of items from low probability categories. This is exactly what happened. There was an interaction between passage and category, F (1,73) = 6.43, $p < .05$. Subjects who read the restaurant passage recalled a mean proportion of .70 of the items from high probability categories whereas subjects who read the supermarket passage recalled .56 of these items, a significant advantage for the former group. With respect to items in the low probability categories, the mean proportions were .65 and .64 for the restaurant and supermarket groups, respectively. The simple main effect of passage for high probability categories was significant, F (1,73) = 12.15, $p < .01$.

Attribution of food items to characters. An initial measure of attribution was the number of food items correctly attributed by a

subject divided by the total number of food items that subject recalled. As had been predicted, there was a difference between passages in favor of the restaurant over the grocery narrative; the means were, respectively, .98 and .88, F (1,69) = 11.20, $p < .01$. Failure to attribute a food item to the proper person could be due to one of two kinds of errors. First, the error might be one of omission. A subject might remember, but fail to mention, the person with the item. This seems especially plausible for people reading the supermarket narrative. For someone shopping at a grocery store, it simply may not seem important to indicate who took a particular item off the shelf. The second type of attribution error is an overt mistake in identifying the person who got an item of food.

There were, in fact, more omissions of attribution as a proportion of food items recalled for the supermarket than the restaurant passage, with mean proportions of .08 and .02, respectively, F (1,69) = 6.75, $p < .02$. However, even when omitted attributions for recalled food items are not considered in the analysis, and the measure is then correct attributions as a proportion of correct plus incorrect attributions, the restaurant passage maintains its superiority over the supermarket passage, with mean proportions of .99 and .96, respectively, F (1,69) = 4.5, $p < .05$.

Order of mention and order of recall. To test how closely a subject's order of recall matched the order of mention in the passage, a Kendall's Tau was computed for each subject. Although the trend in the mean Taus

was in the predicted direction, .83 and .79 for the restaurant and grocery passages respectively, the difference was not significant, $F < 1$. In the preliminary study the difference had been much larger, .87 for the restaurant passage and .56 for the supermarket passage, $t = 2.38$, $p < .05$, perhaps because there was in that study an interval of an hour and a half between reading and recall. It is known that order of mention is accurately reproduced when recall is attempted shortly after reading (cf. Meyer, 1975). Maybe the generic order information inherent in a schema is superflous when surface order information is still available.

Another possibility is that some subjects who received the supermarket passage noticed that the foods purchased could have been used for a gourmet meal at home. A meal-at-home schema could have supported accurate order reproduction and also, incidentally, recall of the food items themselves. While a formal debriefing questionnaire was not presented, three subjects volunteered that they had envisioned a meal at home while reading the supermarket passage. This is an indication that the present study gives a conservative estimate of the effects of high-level schemata.

Recall of identical propositions. As expected, there was no difference in recall of several identical propositions judged to be equally important in the context of a supermarket or restaurant narrative.

Discussion

The research reported here provides unambiguous confirmation that high-level schemata play a role in the learning and remembering of text information. A number of studies have shown that important text

information is more likely to be recalled than unimportant text information (cf. Meyer & McConkie, 1973; Mandler & Johnson, 1976; Brown & Smiley, 1977). The present study differed from these in one significant respect: since the same target information appeared in closely parallel narratives, the superior recall of this information on the part of the restaurant group cannot be attributed to differential learnability or memorability of the target information itself. It appears necessary, therefore, to attribute the contrasting levels of recall to the differences in the high-level schemata evoked by the restaurant and supermarket narratives. Nor does it seem plausaible to attribute the results to a general superiority in the readability, coherence, or interest value of the restaurant passage. For, if this were the case, persons who read the restaurant passage would have done better across the board on every category of text information. In fact, the restaurant group recalled more when and only when the text information had special significance in the light of a restaurant schema. The supermarket group recalled as much as the restaurant group from categories of food that the norming data suggested were optional elements of a restaurant schema, and recalled as much of other text information rated as of equal significance in the context of either a trip to a grocery store or a dinner at a fancy restaurant. These data would appear to preclude any explanation along the lines that the restaurant passage was more comprehensible over all, and that more processing capacity was therefore available to assimilate text information.

In the introduction, predictions were rationalized in terms of the notion that schemata provide the "ideational scaffolding" for text information. According to this hypothesis a high-level schema provides slots for selected categories of text information: if information fits a slot it will be instantiated as part of the encoded representation for the text. We wish to stress here that, while the data are consistent with the ideational scaffolding hypothesis, there are other attractive explanations as well, and the present study does not allow a choice among them. One alternative is that high-level schemata help the reader determine which are the important text elements; further attention is directed to the elements that have been singled out, and it is for this reason that such elements are better learned.

Both the slot-filling and attention-directing explanations suppose processes acting when a passage is read. It is also possible that schemata support processes at work later when information is retrieved. A schema could provide a retrieval plan (Pichert & Anderson, 1977; Bower, 1977). By tracing what is generally true of an evening at a fine restaurant a person may gain access to the information stored when a particular restaurant narrative was read. Or, a schema may help a person recover information by "inferential reconstruction" (Spiro, 1977). For example, a person who does not specifically remember any mention of a beverage being served with the meal, but who has such a slot in his/her schema, may conclude that it must nevertheless have been mentioned. If s/he were to recall that a beef dish was the entree, red wine would

become a candidate beverage. Such candidates may be produced as plausible quesses or, when integral to a coherent account, may be produced with as much confidence as elements that were actually stored. Another possibility is that once a candidate had been generated, it is verified against an otherwise weak or inaccessible memory trace. It will remain for future research to distinguish among these possible processing mechanisms.

Ausubel's conception of the role of abstract knowledge structures was intertwined with the pedagogical notion of "advance organizers," introductions which outline material to follow in abstract, inclusive terms. Most of the research inspired by Ausubel has assessed advance organizers. This research has proved inconclusive (Barnes & Clawson, 1975), giving cause for doubts about the entire theory.

Studies such as the present one show that Ausubel's thinking about the role of abstract knowledge structures in learning from text generally was on the right track. The advance organizer is another matter, however. From the perspective of recent formulations of schema theory, it is difficult to see why outlining subsequent material in abstract, inclusive terms should help readers. When the reader possesses relevant subsuming schemata s/he will routinely bring them to bear, except when the passage is completely obscure, as in the Bransford and Johnson (1973) material, and s/he is unable to discover the aspects of his knowledge that are relevant. But when the reader does <u>not</u> possess relevant schemata,

there is no good reason to suppose that s/he can acquire them from a few abstractly worded sentences (Anderson, 1977). We conclude that the theoretical justification for the advance organizer is quite flimsy.

A general implication for education is that the schemata a person already possesses are a principal determiner of what s/he can learn from a text. Imagine a section from a geography text about an unfamiliar nation. An adult would bring to bear an elaborate nation schema, which would point to subschemata representing generic knowledge about political systems, economics, geography, and climate. Each subschemata would have its own infrastructure and interconnect with other subschemata at various points. It is only a modest oversimplification to say that the chief task for the sophisticated reader would be to instantiate the slots in an already developed knowledge structure with the specific information in the text about the unfamiliar nation.

The young reader, on the other hand, may not possess a nation schema adequate to assimilate the text. For him/her, in the worst case, the material will be gibberish, again like the Bransford & Johnson (1973) passages when readers were not given schema-evoking contexts. More likely, the young reader will have partly formed schemata that will allow him or her to make sense of the passage, but will not permit the construction of mental representations of great depth or breadth. In the best case, a child might develop new high-level schemata from reading a geography text, though this is a matter about which very little is known.

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